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ABSTRACT

This study identified variables which would predict first semester grade point average of nursing students. A variety of academic, psychological, and sociological data were obtained for 630 students attending three schools of nursing within the state of Indiana over a three-year period. High school grade point average, Nelson-Denny vocabulary scores, and student identification of lowest acceptable grades in specific courses were consistently positively correlated with first semester grade point average across campuses and across years. Creativity scores and other biographical data were generally inconsistent predictors of first semester grade point average. (Author/RC)

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VARIABLES RELATED TO ACADEMIC SUCCESS FOR ASSOCIATE DEGREE NURSING STUDENTS

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A paper presented at the annual meeting of the National Council on Measurement in Education, Washington, D.C., April, 1975.

ABSTRACT

The purpose of this study was to identify variables which would predict first semester grade point average of nursing students. A variety of academic, psychological, and sociological data were obtained for 630 students attending three schools of nursing within the state of Indiana over a three-year period. High school GPA, Nelson-Denny vocabulary scores, and student identification of lowest acceptable grades in specific courses were consistently positively correlated with first semester grade point average across campuses and across years. Creativity scores and other biographical data were generally inconsistent predictors of first semester grade point average.

VARIABLES RELATED TO ACADEMIC SUCCESS
FOR ASSOCIATE DEGREE NURSING STUDENTS

A sizeable number of educational institutions have found it necessary to limit the number of students they admit. Several methods have been used to determine which applicants to select for admission and which ones to reject. These have included setting a fixed cut-off score on a single admissions test, using multiple cutting scores with several predictors, and combining predictor data by means of linear multiple regression. Lavin (1965) reviewed all of the research on academic and performance prediction and concluded that multivariate methods which employ multiple predictors and multiple regression analysis or discriminant analysis are essential for productive work in this field.

The administration of preadmission tests, questionnaires, and inventories can be an expensive as well as a time-consuming operation. Hills (1971) suggested that the greatest gain in utility can be obtained by using readily available data as predictors and by using the least expensive measures that yield comparable results. Data on reliability and validity of predictors are necessary for choosing adequate criteria for predicting student academic success.

Predictors in General

Validation of predictors of academic achievement requires the isolation of those variables significantly related to academic performance. Michael, et al. (1971) investigated the predictive power of cognitive and personality variables in nursing education. They concluded that a reading test was the most valid predictor. High school grade averages were also quite good

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predictors, but personality measures (16 PF and MMPI) were of little value.

Willett, and others (1971) studied the validity of a number of cognitive and personality variables as predictors of achievement in nursing school. They concluded that the following were significant and useful predictors: the College Qualification Test, the 16 PF (Personality Factors) Test developed by Cattell, the General Information Questionnaire, the Forer Structured Sentence Completion Test, Ravens Progressive Matrices, and the Minnesota Multiphasic Personality Inventory.

Siegelman (1971) studied the value of SAT scores and high school grade averages for predicting grade point averages of college freshman and sophomores. The results indicated that high school averages were quite valid predictors for men and women, but the SAT was useful only for women and of limited value for predictions in the first two years of college.

Thurston, Brunclik and Feldhusen (1968) developed the Luther Hospital Sentence Completions (LHSC) and a preliminary form of the Nursing Education Scale (NES) to predict success and failure in nursing education. They also evaluated other prediction instruments. Significant differences were noted in terms of Pre-Nursing Guidance Examination scores and rank in high school graduating class between high achievers and low achievers or failures.

Munday and Hoyt (1965) in a study on the use of the American College Test (ACT) in nursing schools, found that the ACT scores appear to be predictive of first-year nursing grades. Their results indicated that prediction systems should be established for individual schools in order to take into account unique aspects of the school's students, policies and educational philosophies.

Owen and Feldhusen (1971) developed multiple regression equations to predict semester grade averages for nursing students. They suggested that the use of

high school grades, and one or two ability meaasures permits economical predictions of the first semester index. For predicting subsequent semester averages, these authors suggested the use of immediately prior semester averages in combination with a reliable ability measure.

Dissinger (1969) developed an inventory which asked students to list the grade which they expected to receive in each course they would be taking and also, the lowest grade they would find acceptable in each course. Results indicated that students' lowest acceptable grade was a better predictor of actual course grades than was the students' grade expectations.

Owen and Feldhusen (1970) conducted a study to compare the effectiveness of three prediction models of academic success in nursing education. The model demonstrated to be the most efficient consistently entered lowest acceptable grade point average as a predictor variable in analyses to determine optimum predictor sets. The final optimum battery in which this variable was included demonstrated that "lowest acceptable grade point average" variable made a significant contribution to the accuracy of the predictions of actual grade point averages.

The above studies indicate that cognitive as well as non-cognitve variables were useful predictors of academic achievement. A combination of those variables would certainly improve the accuracy of subsequent predictions beyond any single predictor. A good battery of predictors for academic performance might then include indices of previous achievement, selected personality variables, and relevant biographical data.

Purpose

This study was designed to show the relationships between acadmic, psychological, and sociological variables and first semester grade point average (GPA). The greatest percentage of students who leave the university because of academic

problems do poorly in the first semester. The study was designed to answer the following question: Which variables are most consistently related to first semester GPA for entering students at three schools of nursing over a three-year period?

DATA SOURCES

Predictor Data

Data for a total of 31 predictor variables were gathered from student academic folders and from a 90-minute administration of tests and questionnaires. Data obtained from academic folders included: age, high school rank, high school grade average in math, science, and English courses, overall high school GPA (in math, science, and English), amount of previous education, and probation status.

Each year before the first full week of classes, four instruments were administered to entering nursing students. They included an anxiety scale, a creativity scale, a flexibility of thinking scale, and an information questionnaire. The anxiety scale provided scores for general anxiety and test anxiety. The Creativity Self-Report Scale developed by Feldhusen, Denny and Condon (1965) provided a total score, a score of 19 items which yielded discrimination indices of .30 or more in a global item analysis, and three factor scores. The three factor scores included: 1) cognitive complexity, innovation and curiosity; 2) risk-taking, impulsive behavior, and an indifference toward others' views of the respondent; and 3) creative imagination. Flexibility of thinking was measured by the Alternate Uses test developed by Wilson, et al. (1960). The Information Questionnaire was administered to provide information concerning occupational status and educational level of the student's mother and father and also the student's lowest acceptable grades in specific freshman

courses.

In 1970, an attempt was made to record Scholastic Aptitude Test (SAT) scores for entering nursing students. Since SAT results were available for only half of these students, the Nelson-Denny Reading Test was substituted for use in 1971 and 1972. This instrument is a reading achievement test which measures vocabulary, comprehension, and reading rate.

Participating Schools

Students involved in this study were enrolled at one of three associate degree nursing programs in the state of Indiana. All schools were accredited by the National League for Nursing. The director of nursing at each campus assisted in obtaining student data.

Students

Data were gathered for a total of 630 students who entered one of the three schools of nursing in 1970, 1971, and 1972 (see Table 1). Data were obtained from student academic folders and from a 90-minute administration of tests and questionnaires during orientation week.

TABLE 1. Number of Students by Campus and Year

	Campus			
Year	A	B	C	Total
1970	133	36	57	226
1971	76	30	33	139
1972	153	44	68	265
Total	362	110	158	630

METHOD

Twelve sets of correlations were computed with each of the 31 predictor variables and first semester GPA. These correlation coefficients were calculated separately in each of the three campuses and for all campuses combined. It was thus possible to learn how closely the variables correlated with first semester GPA at three schools of nursing over a three-year period.

In addition, 12 stepwise multiple regression equations were developed. These included equations developed each year for each campus, and equations developed each year for all three campuses combined. All equations were developed to the sixth step. Missing data were replaced by using the mean of each variable for each school and year. The SPSS REGRESSION program was used to analyze the data.

A record was made to show the frequency of occurrence of each of the predictor variables in the 12 stepwise multiple regression equations. In addition, predictor variables were assigned progressively decreasing values (weights) as they successively entered each of the stepwise regression systems. Weights were assigned to approximate each variable's status in each regression system. The weights assigned to predictor variables in the 12 regression equations were then summed to provide an overall picture of the occurrence of each variable.

The predictor variables were given weights from ten to one depending upon the step at which they entered into the equations. Variables which entered an equation on the first step were assigned a value of 10; variables entering on the second step, 7; third step, 5; fourth step, 3; fifth step, 2, and sixth step, 1. Predictor variables which enter first in a regression equation are the ones most closely related to the criterion. Hence, the first variable to enter an equation was given the greatest weight (10). Variables entering prediction

equations in the second and third steps are usually also relatively important contributors although to a somewhat lesser degree. Thus these variables were given weights of 7 and 5 respectively. Since the greatest proportion of variance is usually accounted for by variables in the first three steps, variables entering in the fourth, fifth, and sixth steps were given the lowest weights (3, 2, and 1 respectively). The overall total of these weights provides only a very general picture of variable usage. The principal limitation lies in the fact that once one or more variables have entered a stepwise regression system, the order of entry of successive variables is dependent upon their relationship with the criterion and with the variable or combination of variables which have already entered.

Operational validity coefficients for the regression equation formulas developed from the 1970 data were completed. These were done by correlating predicted and actual first semester GPA's for student data from 1971. Operational validity coefficients for formulas developed from 1971 student data were obtained by correlations with student data from 1972. These validations were done to illustrate the importance of including reliable predictor variables in the prediction equations.

RESULTS

Correlations for the 31 variables and first semester GPA are presented in Table 2. The variable showing the highest and most consistent correlations with first semester GPA over campuses and years was the student's overall high school GPA. Correlations were all positive and ranged from .15 to .55. High school averages in math, science, and English generally correlated only slightly lower with first semester GPA than did the overall high school GPA. Scores on two sections of the Nelson-Denny Reading Test had generally high positive correlations with first semester GPA. Nelson-Denny vocabulary correlations

ranged from .30 to .49, while Nelson-Denny comprehension correlations ranged from .21 to .37. Students' lowest acceptable grades for specific courses were also consistently positively related to actual first semester GPA.

Marital status and previous nursing experience generally had low but consistently positive correlations with first semester GPA. Probation status and test anxiety were always negatively related to first semester GPA. Occupational and educational level of the students' parents, flexibility of thinking scores, and creativity scores were inconsistent in their relationship to the criterion.

Regression Equations

The multiple correlations coefficients for predicting first semester GPA are presented in Table 3. For the stepwise multiple regression equations developed in 1970, 1971, and 1972 at each campus, all 12 multiple R's were .48 or higher after the sixth step has been reached.

Table 4 presents a summary of the steps at which variables entered into the 12 regression equations. High school overall GPA, Nelson-Denny Vocabulary scores, and students' lowest acceptable grades in English courses were used most frequently and generally entered early into the equations. The high school overall GPA was used in 7 of the 12 regression equations and received a weighted total of 62. The Nelson-Denny Vocabulary score was used 5 times with a weighted total of 34. The students' lowest acceptable grade in English was also used 5 times but had a weighted total of 30. All but six of the 31 variables entered an equation at least once. Predictor variables which were seldom used included age, general anxiety, flexibility of thinking, parent occupation and education, and Nelson-Denny reading rate.

Operational Validations

Tables 5 and 6 present operational validity coefficients for predicting first semester GPA's for students who entered one of the schools of nursing in 1971 and 1972. The formulas developed from 1970 student data were used to predict GPA's for 1971 students. Likewise, the formulas developed from 1971 student data were used to predict GPA's for 1972 students.

Since the Nelson-Denny Reading Test was not administered in 1970, the three scales from this instrument could not be used to develop regression equation formulas for this year. The 28 remaining variables were used in 1970. All 31 variables were used to develop regression equations with the student data from 1971.

Six stepwise multiple regression formulas were developed at each campus. The first prediction equation included only the variable which correlated highest with first semester GPA. The second equation involved the use of two variables: the variable used in the first step and another variable which had the highest partial correlation with first semester GPA. The third equation involved the use of the previous two variables plus a third predictor variable. The fourth, fifth, and sixth equations used four, five, and six predictor variables respectively.

The importance of using reliable predictors is illustrated in Tables 5 and 6. For example, in Table 6 at Campus C one can see that creativity total score was inconsistently related to first semester GPA. In 1971, creativity total correlated negatively (-.29) with first semester GPA while in 1972 there was a low but positive correlation (.08) with first semester GPA. When the regression equations were developed on 1971 student data, the multiple regression coefficient increased with the addition of new variables into the equation (.55 1st, .65 2nd, .74 3rd, .78 4th, .80 5th, .82 6th). However,

when these equations were used with student data from 1972, a good amount of shrinkage resulted (.34 1st, .41 2nd, .26 3rd, .16 4th, .10 5th, .09 th). The greatest amount of shrinkage occurred in the third step when creativity total was used in the prediction equation.

SUMMARY

There are a variety of predictor variables which educational institutions can and have used in making decisions as to which students they should select for admission. In this study, 31 variables were examined for 630 students at three schools of nursing over a three-year period. Overall high school GPA and vocabulary scores from the Nelson-Denny Reading Test appeared to be the highest and most consistent predictors of first semester GPA. A great deal of shrinkage occurred in the multiple regression prediction equations when unreliable predictors were included in the prediction battery. It is therefore recommended that institutions which rely upon prediction equations for student selection use reliable variables and annually validate their prediction formulas.

TABLE 2. Correlations for 31 Academic, Psychological, and Biographical Variables with First Semester GPA across Campuses and over a Three - Year - Period

Year	CAMPUS					CAMPUS				
	Variable	A	B	C	ABC Combined	Variable	A	B	C	ABC Combined
1970	1.Age	.01	.37	-.07	.06	17.HS Overall	.39	.33	.20	.33
1971		.16	.21	.18	.19		.43	.54	.55	.48
1972		.06	.01	.00	.03		.15	.45	.34	.26
1970	2.General	-.06	-.15	-.07	-.06	18.Previous	.00	-.05	.28	.01
1971	Anxiety	-.03	30	-.15	.00	Education	.20	-.07	-.18	.02
1972		.03	-.02	-.17	-.02		.29	.32	.16	.25
1970	3. Test	-.26	-.09	-.23	-.22	19.HS Rank	.31	.32	.15	.27
1971	Anxiety	-.08	-.21	-.03	-.10		.31	.29	.30	.30
1972		-.11	-.45	-.13	-.17		.03	.45	.36	.21
1970	4.Creativity	.25	.16	.20	.22	20.Marital	.10	.51	.13	.19
1971	(Total Score)	-.22	.06	-.29	-.16	Status	.13	.23	.37	.22
1972		.01	-.02	.06	.02		.16	.04	.10	.12
1970	5.Creativity	-.13	.23	.13	-.05	21.Probation	-.23	-.29	-.08	-.18
1971	Factor 1	-.14	.09	-.06	-.06	Status	-.33	-.27	-.20	-.27
1972		-.03	-.02	-.01	-.02		-.11	-.34	-.20	-.17
1970	6.Creativity	.18	.04	.26	.17	22.Nelson-	Not administered in 1970			
1971	Factor 2	-.17	.02	.01	-.08	Denny (N-D)	.38	.40	.30	.33
1972		.12	.19	.12	.13	Vocabulary	.35	.49	.47	.41
1970	7.Creativity	-.24	.40	.02	-.11	23.N-D	Not administered in 1970			
1971	Factor 3	-.24	.30	-.19	-.11	Comprehension	.35	.24	.21	.28
1972		-.01	.10	.07	-.03		.35	.34	.40	.37
1970	8.Creativity	-.19	.23	.12	-.11	24.N-D Reading	Not administered in 1970			
1971	Item Anal.	-.28	.17	-.08	-.12	Rate	.17	.08	-.03	.10
1972		-.02	.08	-.02	-.01		.13	.32	.39	.25
1970	9.Flexibility	.23	.20	.02	.15	25.Previous	.11	.23	-.05	.08
1971		.05	.25	-.09	.06	Nursing	.04	-.21	-.12	-.08
1972		.14	.37	.24	.20	Experience	Not administered in 1972			
1970	10.Father's	-.06	.14	-.10	-.04	26.L.A.G. in	.22	.29	.33	.26
1971	Occupation	-.07	-.28	-.29	-.15	Anatomy &	.25	.18	.20	.22
1972		-.10	.04	.12	.00	Physiology	.05	-.07	.10	.05
1970	11.Father's	.13	.03	.15	.09	27.L.A.G. in	.24	.17	.42	.27
1971	Education	.03	.02	.03	.02	English	.28	.10	.50	.29
1972		.04	-.01	-.22	-.05		08	-.05	.29	.14
1970	12.Mother's	.00	.15	.20	.07	28.L.A.G. in	.10	.40	.09	.13
1971	Occupation	-.06	.09	.07	.00	Fundamentals	.08	.23	.17	.14
1972		-.11	.28	.02	-.01	of Nursing	-.11	.08	.15	.00
1970	13.Mother's	.14	.17	.03	.09	29.L.A.G. in	.14	.33	.14	.18
1971	Education	-.08	-.05	.00	-.05	Psychology	.07	.37	.47	.24
1972		.02	-.28	-.12	-.06		.16	.30	.43	.28
1970	14.High	.37	.33	.08	.28	30.L.A.G. in	.16	.28	.33	.23
1971	School (HS)	.45	.48	.50	.47	Microbiology	.15	.15	.35	.21
1972	English	.07	.50	.41	.25		-.01	.38	.20	.14
1970	15. HS Math	.33	.28	.24	.33	31.L.A.G. for	.24	.43	.05	.24
1971		.33	.49	.48	.41	1st Semester	.12	.16	.30	.19
1972		.16	.23	.23	.19	GPA	.00	.18	.30	.13
1970	16. HS Science	.36	.31	.18	.30					
1971		.39	.53	.38	.43					
1972		.13	.44	.26	.21					

* L.A.G.= Students' stated lowest acceptable grade.

TABLE 3. Multiple Correlations for Each of the Six Steps by Campus and Year

Campus	Year	Multiple R					
		Step Number					
		1	2	3	4	5	6
A	1970	.39	.48	.51	.55	.57	.59
	1971	.45	.55	.59	.62	.66	.67
	1972	.35	.40	.43	.45	.46	.48
B	1970	.52	.71	.77	.81	.84	.85
	1971	.54	.63	.68	.72	.75	.78
	1972	.50	.60	.64	.67	.69	.71
C	1970	.42	.48	.52	.55	.58	.59
	1971	.55	.65	.74	.78	.80	.82
	1972	.47	.57	.61	.63	.65	.57
ABC Combined	1970	.34	.41	.45	.49	.52	.53
	1971	.48	.55	.58	.60	.61	.62
	1972	.42	.45	.47	.48	.50	.52

TABLE 4. Summary of Steps at Which Variables Entered into the 12 Regression Equations

Variables	Weights 1st	2nd	3rd	4th	5th	6th	Total	Weighted Total
17. HS Overall	5	1	1	-	-	-	7	62
22. N-D Vocabulary	3	-	-	-	2	-	5	34
27. LAG in English	1	2	1	-	-	1	5	30
14. HS English	2	-	-	2	-	-	4	26
20. Marital Status	1	1	1	-	-	1	4	23
18. Previous Education	-	1	2	1	-	-	4	20
3. Test Anxiety	-	1	1	-	2	-	4	16
8. Creativity-Item Anal.	-	-	1	2	2	-	5	15
6. Creativity-Factor 2	-	1	-	1	2	1	5	14
26. LAG in Anat. & Phy.	-	2	-	-	-	-	2	14
29. LAG in Psychology	-	1	1	-	-	-	2	12
15. HS Math	-	-	1	1	-	1	3	9
16. HS Science	-	-	1	-	1	1	3	8
1. Age	-	1	-	-	-	-	1	7
4. Creativity Total	-	-	1	-	1	1	3	8
11. Father Education	-	1	-	-	-	-	1	7
5. Creativity-Factor 1	-	-	-	-	2	1	3	5
31. LA 1st Sem. GPA	-	-	1	-	-	-	1	5
9. Flexibility	-	-	-	1	-	1	2	4
21. Probation Status	-	-	-	1	-	1	2	4
13. Mother Education	-	-	-	1	-	-	1	3
23. N-D Comprehension	-	-	-	1	-	-	1	3
25. Prev. Nursing Exper.	-	-	-	1	-	-	1	3
19. HS Rank	-	-	-	-	1	-	1	2
10. Father Occupation	-	-	-	-	1	-	1	2
12. Mother Occupation	-	-	-	-	-	1	1	1
2. General Anxiety	-	-	-	-	-	-	0	0
7. Creativity-Factor 3	-	-	-	-	-	-	0	0
24. N-D Reading Rate	-	-	-	-	-	-	0	0
28. LAG Fund. of Nursing	-	-	-	-	-	-	0	0
30. LAG Microbiology	-	-	-	-	-	-	0	0
TOTAL	12	12	12	12	12	12	72	

TABLE 5. Operational Validity Coefficients for Predicting First Semester GPA for Stepwise Multiple Multiple Regression Equations Developed in 1970

Data Base Year / Correlation Technique				1970		1971	
				Multiple R	Simple r	Oper-Val r	Simple r
Campus	NVE[1]		Variable				
A	1	17.	HS Overall	.39	.39	.43	.43
	2	26.	LAG in A & P	.48	.22	.51	.25
	3	3.	Text Anxiety	.51	-.26	.52	-.08
	4	9.	Flexibility	.54	.23	.44	.05
	5	16.	HS Science	.57	.36	.44	.39
	6	27.	LAG in English	.59	.24	.46	.28
B	1	20.	Marital Status	.51	.51	.23	.23
	2	17.	HS Overall	.71	.33	.58	.54
	3	8.	Cr. Item Anal.	.77	.23	.60	.17
	4	25.	Prev. Nurs. Exper.	.81	.23	.57	-.21
	5	19.	HS Rank	.84	.32	.52	.29
	6	6.	Cr. Factor 2	.85	.04	.47	.02
C	1	27.	LAG in English	.42	.42	.50	.50
	2	6.	Cr. Factor 2	.48	.26	.44	.01
	3	31.	LAG for 1st Sem.	.52	.05	.36	.30
	4	15.	HS Math	.55	.24	.41	.48
	5	3.	Text Anxiety	.58	-.23	.36	-.03
	6	12.	Mother's Occup.	.59	.20	.39	.07
ABC Combined	1	17.	HS Overall	.33	.33	.48	.48
	2	26.	LAG in A & P	.41	.26	.51	.22
	3	20.	Marital Status	.45	.19	.55	.22
	4	6.	Cr. Factor 2	.49	.17	.49	-.08
	5	3.	Test Anxiety	.52	-.22	.50	-.10
	6	8.	Cr. Item Anal.	.53	-.11	.49	-.12

[1] NVE means Number Of Variables entered in each regression equation

TABLE 6. Operational Validity Coefficients for Predicting First Semester GPA for Stepwise Multiple Regression Equations Developed in 1971

Data Base Year / Correlational Technique				1971		1972	
				Multiple R	Simple r	Oper-Val r	Simple r
Campus	NVE[1]		Variable				
A	1	14.	HS English	.45	.45	.07	.07
	2	27.	LAG English	.55	.28	.10	.08
	3	18.	Prev. Educ.	.59	.20	.21	.29
	4	8.	Cr. Item Anal.	.62	-.28	.21	-.02
	5	22.	N-D Vocab.	.66	.38	.32	.35
	6	21.	Prob. Status	.67	-.33	.27	-.11
B	1	17.	HG Overall	.54	.54	.45	.45
	2	1.	Age	.63	.21	.41	.01
	3	18.	Prev. Educ.	.68	-.07	.11	.32
	4	21.	Prob. Status	.72	-.27	.21	-.34
	5	8.	Cr. Item Anal.	.76	.17	.13	.08
	6	4.	Cr. Total	.78	.06	.15	-.02
C	1	17.	HS Overall	.55	.55	.34	.34
	2	27.	LAG in English	.65	.50	.41	.29
	3	4.	Cr. Total	.74	-.29	.26	.08
	4	8.	Cr. Item Anal.	.78	-.08	.16	-.02
	5	22.	N-D Vocab.	.80	.30	.10	.47
	6	16.	HS Science	.82	.38	.09	.26
ABC Combined	1	17.	HS Overall	.48	.48	.26	.26
	2	20.	Marital Status	.55	.22	.28	.12
	3	27.	LAG English	.58	.29	.30	.14
	4	14.	HS English	.60	.47	.31	.25
	5	10.	Father Occup.	.61	-.15	.31	.00
	6	4.	Cr. Total	.62	-.16	.29	.02

[1] NVE means Number of Variables entered in each regression equation

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